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EXPERIMENTS
SHEWING THAT
VOLATILE ALKALI FLUOR
IS THE
MOST EFFICACIOUS REMEDY
In the CURE of
ASPHYXIES;
(Or APPARENT DEATH by Drowning, &c.)
WITH
REMARKS
UPON THE
Advantageous EFFECTS produced by it in the BITE of the VIPER, CANINE MADNESS, BURNS, APOPLEXY, &c.

Tranſlated from the French of M. SAGE,
By THOMAS BRAND,
MEMBER of the CORPORATION of SURGEONS, LONDON.

Contraria contrariis curantur.

ARISTOT. Probl. 1.

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BY THE

TRANSLATOR.

THE benevolent tendency of this work will be a ſufficient apology for preſenting it to the Reader in an Engliſh Dreſs. The attention of the Faculty has been lately turned upon the means of recovering perſons apparently dead, particularly by drowning; and their ſucceſs has been ſuch as to merit the applauſe and gratitude of the Public. Every thing, therefore, that can aſſiſt in promoting this uſeful purpoſe, has a claim to a favourable reception.

M. Sage, the Author of the following performance, is a Gentleman of eminence and character. The work has been ſo well received in France, as in a few months to have run thro' two Editions, and has been approved of by ſeveral Gentlemen of the Faculty who have ſeen it here. The Tranſlator can even ſay, that he has repeated ſome of the Experiments mentioned in it, which perfectly ſucceeded.

Of the merits of the Tranſlation, the Public muſt be left to judge. Leſs ſolicitous to pleaſe, than to inform his Reader, the Tranſlator principally attached himſelf to give a faithful tranſcript of his Author's meaning. In a Work of Science elegance of ſtile is often impoſſible; however, it is to be hoped the preſent Verſion will be found paſſable; and that whatever ſlips may be diſcovered in it will be pardoned, on account of the importance of the ſubject.

Leicester-Square,
Jan. 18, 1778.

ADVER-

ADVERTISEMENT

By M. SAGE.

THE great number of Experiments by which I have been led to determine the cauſe of the Aſphyxy, (or apparent death) have at the ſame time taught me that Volatile Alkali, far from being looked upon as an acceſſary, or as a ſimple ſtimulant in the treatment uſual in ſuch caſes, ought on the contrary to be employed in preference to every other remedy. But it is proper, in the firſt place, to obſerve, that Volatile Alkali does not act efficaciouſly, except when the diſeaſes for which I propoſe it to be uſed have been produced by ſome acid, ſuch as that which acts upon the lungs, in the greateſt part of Aſphyxies. If the ſame Volatile Alkali acts as a remedy againſt the venom of the viper, the reaſon is, becauſe that venom is of an acid nature, as has been demonſtrated by Dr. Mead and Dr. James.

Ants, Gnats, Waſps, and ſeveral other Inſects, only produce their miſchief by the acid which they introduce into the punctures they make in us. Even the burn, as I have ſhewn in another place, is only the effect of a concentrated acid, which attacks the texture of the ſkin with more or leſs violence.

The greateſt part of theſe obſervations being ſcattered in my works, or not having been yet publiſhed, I conſidered it as my duty to collect and communicate them to *Monſ. le Noir*, Lieutenant-General of the Police, before whom I have repeated my principal Experiments. This magiſtrate, always attentive to the good of the public, has not only ſignified his peculiar ſatisfaction, but judged that I could not too ſoon publiſh a method ſo ſimple and ſure for curing a great many accidents, cauſed as well by the acid and deadly vapour of fermentations, as by the vapour, equally acid, of charcoal, the mephitic effluvia of jakes, and a number of other circumſtances which, for want of an eaſy and ready remedy, daily expoſe the citizen to paſs from a ſtate of apparent to that of real Death.

To imagine that I intend to introduce the Volatile Alkali as an univerſal remedy, would be extremely abſurd; I repeat, that it is only proper for thoſe affections and diſeaſes produced by an acid, and that its application muſt be made very quickly if we wiſh it to produce diſtinguiſhed effects: beſides this I muſt add, if it is uſed improperly, as in places where putrid contagions exiſt, or where the diſpoſition of the animal œconomy tends to an Alkali, Scurvy, &c. this remedy ſo ſalutary, in many caſes, may become hurtful.

The uſe of the Volatile Alkali muſt of courſe be abſolutely forbidden in the plague, but in this caſe the acids ſucceed.

As the immediate cauſe of the plague is the ſubtile contagion produced by putrid vapour (*a*), acids muſt be the moſt proper to ſtop its progreſs.

(*a*) See the *Journal de Phyſique*, for Auguſt 1773, the treatiſe of Dr. Mauduit, entitled: *Experiences à tenter pour parvenir à determiner la nature du venin peſtilentiel, &c.*

"It is ſaid there that all circumſtances unite in "proving that this poiſon is a Volatile Alkali of "the pureſt kind."

One of the ſureſt methods of preventing the contagion, as well as the diſeaſes people may be expoſed to in hot and marſhy countries, is to be well rubbed before a clear fire morning and evening, and at the ſame time to have the cloaths well aired; the acid exhaled from combuſtible bodies purifies the atmoſphere, and deſtroys the contagion which may get into the body, or remain in the cloaths.

I have been aſſured that near Peſti, anciently called Pæſtum, in the neareſt principality of the kingdom of Naples, there are places where the air is ſo unhealthy, that it is hardly poſſible to live in them; nevertheleſs there are inhabitants many of whom arrive to a great age, without any other precaution againſt the effects of the bad air which they breathe in thoſe places, except that of ſeating themſelves in the morning before going out, and in the evening after returning home, before a clear fire, at which they likewiſe air their cloaths.

Dr. Mauduit gives us in his learned treatiſe, which I have juſt cited, ſome paſſages, proving that the Grecians eſteemed fire as the moſt proper agent to purify the air: " Theſe people, during the time of the plague, " ran (ſays he) to light torches at the altar of " Jachen, the Egyptian, who had firſt taught " them to cure contagious diſeaſes by means " of fire, and to whom, long before the time " of Hippocrates, altars had been raiſed by the " public gratitude.

" Plutarch gives an account, that Acron " acquired great honour at a time when the " plague raged at Athens, by having directed " fires to be made near every infected per- " ſon.

" Hippocrates, not content with adviſing " fires to be kept conſtantly burning in the " ſtreets, lanes, and ſquares of Athens, like- " wiſe ordered baſkets of odoriferous flowers " to be ſet, and perfumes and ſpices to be " ſtrewed in them."

The acid of vinegar is a no leſs proper antidote againſt the peſtilential poiſon than that of fire. " Vinegar, ſays Mr. Geoffroy " in his *Materia Medica*, furniſhes us with " one of the beſt preſervatives againſt ma-

“ lignant, peſtilential fevers, and againſt “ the plague; it is uſed either ſimple or “ pounded with *Alexiteries:*” the famous *Vinegar des Quatre Voleurs* is of this latter kind. Common vinegar taken in the form of lemonade, and uſed as a waſh, is preferable to milk and emulſions in accidents cauſed by copper, arſenic, antimony and lead (*b*). It is likewiſe uſed with the greateſt ſucceſs againſt the deadly poiſon of the *Bella-donna* (*c*); but in aſphyxies it would rather be hurtful than of ſervice, theſe being generally produced by an acid taint, as will be ſeen afterwards.

(*b*) Mr. Navier, Doctor of Phyſic, has lately publiſhed a work entitled, *Antidotes againſt arſenic, corroſive ſublimate, verdigris and lead:* he there points out *Hepar* of ſulphur as the principal remedy, and vinegar as a preparative.

(*c*) See my *Analyſis of Corn*, pag. 112, and the following.

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EXPERIMENTS, &c.

Of Volatile Alkali.

VOLATILE Alkali *(a)* is the ſame in the animal, vegetable, and mineral kingdoms, differing only in its degrees of purity; the more it is impregnated with oil, the leſs efficacious it is; for which reaſon *Eau de Luce*, where it is almoſt in a ſaponaceous ſtate, produces not ſo quick effects as Volatile Alkali *(b)* Fluor.

(a) It is likewiſe known by the names of *Spirit of Sal Ammoniac*, *Urinous Spirit*, *Spirit of Harts-horn*, *Salt of England*, and laſtly, *Eau de Luce*, when it is reduced to a milky ſtate, by being combined with an eſſential oil.

(b) I mean under this name the Volatile Alkali diſengaged from Sal Ammoniac by three parts of ſlaked lime; I name it *Fluor*, becauſe it is always in form of a fluid.

Volatile Alkali is never found by itſelf in mixt bodies; when met with in vegetables and animals, it is always combined with an acid; in the mineral kingdom it is often found in the ſtate of *Hepar* of ſulphur, or in that of Sal Ammoniac in the eruptions of volcanos; or laſtly, combined with certain metallic ſubſtances, as copper, mercury, &c. See the 2d edition of my *Elements of Mineralogy*.

That volatile, ſtrong-ſmelling, ſaline ſubſtance of which I am ſpeaking, has obtained the name of Alkali, becauſe it has been diſcovered to poſſeſs ſome properties of the ſalt obtained from the herb *Kali* or *Salt-wort*: both theſe Alkalis give a green colour to the blue tincture of violets, and have the ſame principles *(c)*; but the phoſphoric acid appears to be more attenuated in the Volatile Alkali.

Tho' Volatile Alkali be but of one ſpecies; it is no leſs true that it differs in ſtrength according to the proceſs uſed for diſengaging it from its baſis: the leſs oily the more volatile it is, and the more proper for relieving the Aſphyxy.

(c) Volatile Alkali is compounded of a phoſphoric acid, an abſorbent earth, and an oily and phlogiſtic matter, to which it owes its ſmell. It is found in all Diſpenſaries.

Pro-

Proceſs for obtaining Volatile Alkali Fluor.

IN order to get Volatile Alkali Fluor from Sal Ammoniac, one part of that ſalt pulverized muſt be mixed with exactly three parts of ſlaked lime, the mixture put into a luted retort, and after pouring water on it (d), fit and lute a large receiver, whoſe *foramen* muſt be left open. During the diſtillation, a great quantity of air is formed; this air carries with it a very penetrating Volatile Alkali, which may be ſtopped by making it paſs thro' a quantity of diſtilled water, in which the Alkali remains while the air eſcapes.

This Volatile Alkali is very ſtrong, when from the mixture in which a pound of Sal Ammoniac is uſed, you extract no more than a pound of the fluid. The Volatile Alkali Fluor obtained by the proceſs juſt deſcribed is limpid, very penetrating, and the only one that ought to be uſed, as the ſpecies of cauſticity peculiar to it, renders it more efficacious than any other. Great care muſt be taken not to make it milky by a mixture of an eſſential oil; for then it is almoſt in a ſoapy ſtate, and forms what is called *Eau de Luce.*

(d) The quantity of water I uſe is equal to that of Sal Ammoniac.

Proceſs for obtaining Concrete Volatile Alkali.

TO draw Concrete Volatile Alkali from Sal Ammoniac, one part of the ſalt muſt be diſtilled in a luted glaſs-retort, with one part and a half of fixed Alkali of Tartar *(e)*; a fuſeau and receiver are fixed to the retort, and the diſtillation is performed by the graduated fire of a reverberating furnace; the Concrete Alkali coats the ſides of the fuſeau. This ſalt evaporates in air: if diſſolved in water, it is called, *Spirit of Sal Ammoniac.*

The Volatile Alkali obtained by this proceſs has leſs ſmell and ſtrength than that got by means of the lime, as it contains a great deal more of unctuous matter.

The Volatile Alkali diſtilled from animal ſubſtances has the ſame properties with the concrete; if it has not been ſeparated entirely from the animal oil, it retains its ſmell: in general Alkalis have leſs ſtrength in proportion to the quantity of oil they contain.

A well rectified Concrete Volatile Alkali extracted from ſilk has been made uſe of by the name of *Salt of England:* others have uſed under that ap-

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(e) If the Alkali of Saltwort was uſed in decompounding Sal Ammoniac, this Natrum retaining the water of the cryſtallization, the Volatile Alkali got would be partly fluid.

pellation a mixture of Sal Ammoniac and ſlaked lime in a bottle well ſtopped, ſo that the ſeparation of the Volatile Alkali by the lime is performed the moment that the bottle is opened, and ceaſes as ſoon as it is ſtopped.

I. OF THE ASPHYXY PRODUCED BY THE MEPHITIC ACID OF VINOUS FERMENTATION.

ON the 10th of May, 1777, Count Falkenſtein (the Emperor) having paid a viſit to the Academy of Sciences, M. Lavoiſier repeated before him ſome of Dr. Prieſtley's experiments on *fixed air* (*f*). He put a ſparrow into a receiver, when immediately on introducing a quantity of fixed air, the bird was violently agitated, and a little after fell upon its ſide. M. Lavoiſier took it out of the receiver, and preſented it as dead to the Count.--- Having asked for the bird, I poured about a drachm of Volatile Alkali Fluor into the hollow of my hand, and dipped the creature's bill into it. On the firſt ſign of motion it gave, I laid it on the table; but ſcarce had it ſtretched out its wings when

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(*f*) A name improperly given to a Volatile Acid, to which I have given that of *Marine Volatile Acid*, and which from its deleterious properties may be called *Mephitic Acid.*

when it relapſed: I again adminiſtered ſome Volatile Alkali to it, which compleated its effect. The animal had ſtrength enough to keep upon its legs; it hopped, ſhook its wings, and took flight. The windows were opened, and the little creature, thus reſtored to life, flew off with the utmoſt ſpeed.

I had never tried this experiment on birds, but I had been fortunate enough to reſtore to life ſome people who had been ſuffocated, (either by the acid vapour of charcoal, or vinous fermentation) by injecting Volatile Alkali into their noſtrils, and making them take it in water. This method has been attended with the ſame good effects in apoplexies, as I have ſhewn *page* 26. *et ſeq.* of the firſt Vol. of my *Elements of Mineralogy*: accordingly I have not heſitated to recommend it (*Ib.* pag. 31.) in Aſphyxies produced by the acid vapours which go by the name of *fixed air*.

Aſphyxy, every one knows, is the ſudden privation of the pulſe, of reſpiration, of feeling and motion: this ſtate precedes death occaſioned by the mephitic and acid effluvia of burning charcoal, liquors in fermentation, &c. I have lately verified the good effects of Volatile Alkali in thoſe caſes, by repeating my experiments on a great number of birds and other animals, which I placed into the acid vapour of beer in fermentation.

I have varied theſe experiments in every poſſible degree, and in ſuch a manner as to cancel all doubt with reſpect to the dreadful effects of this acid, and the method I believe moſt proper to apply a ſpeedy remedy.

I have diſcovered that the deſtructive action of the pretended *fixed air*, upon animals, was more or leſs rapid according to the advance made in the vinous fermentation by which it was generated. In fact, tho' this acid, in the firſt moments of fermentation, extinguiſhes lights as ſuddenly as when it is drawing near its end, yet it is not then equally capable of ſuddenly deſtroying the life of animals plunged into it; as I have proved by experiment in the brewery of Mr. de Longchamp. (g)

Being deſirous of determining with certainty whether vinegar as well as Volatile Alkali had the power of recovering animals ſuffocated by the acid vapour of vinous fermentation, I introduced into a large receiver, where I had put two ſparrows, a quantity of Volatile Acid, or *fixed air*, taken from a vat of beer where the vinous

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(g) This Citizen is one of the greateſt improvers of the art of Brewing that France has produced; it is eaſy to be convinced of this by a ſight of his brew-houſes; the kiln in which he dries his malt, is built on his own principles in the moſt ingenious manner.

ferſermentation was beginning, and in which a wax taper was immediately extinguiſhed; the birds were violently agitated, and fell upon their ſide without being able to riſe: their eyes cloſed: their reſpiration became ſlow and difficult, tho' they opened their bills wide. After leaving them ſeven minutes in this critical ſituation, I put them into a veſſel filled with real air: they then opened their eyes, got upon their legs, breathed freely, and reſumed all their activity: upon immerging them again in the acid atmoſphere of the vat, they died in two minutes.

Having put two other birds into a receiver, I introduced into it more Volatile Acid taken from the ſame vat two hours after the former, (that is, when the vinous fermentation was nearly compleat): in three ſeconds the animals fell upon their backs, and in ſix ſeconds more ſunk into an Aſphyxy.

I dipped the bill of one of them into vinegar, and not perceiving it at all relieved, I endeavoured to pour ſome down its throat, but found it impoſſible to recover it. The other bird whoſe bill I dipped in fluid Volatile Alkali, in two ſeconds recovered its reſpiration, moved its limbs, hopped, and then flew away.

I have repeated this experiment ten times, and always with equal ſucceſs: that is to ſay, the bird to which the Volatile Alkali was adminiſtered recovered its life *(h)*, while that on which I tried only the vinegar remained dead. At other times I have ſeen vinegar accelerate the death of birds that were not in a complete ſtate of aſphyxy: I have even obſerved, that in the caſe where I firſt had recourſe to vinegar, the Volatile Alkali was afterwards employed without any kind of ſucceſs.

I dare therefore affirm, on the authority of thoſe re-iterated experiments, that the Volatile Alkali Fluor appears to me the moſt efficacious method of remedying almoſt inſtantaneouſly the fatal effects of that Volatile Acid known by the names of *Gas* and *Fixed Air:* as ſoon as that Acid is combined with the Alkali preſented to it, there reſults a mixture entirely innocent, and the ſpaſm occaſioned by the penetration of the Acid into the lungs *(i)* ceaſes immediately. Boerhaave relates, that he ſhould have been ſuffocated by an

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(h) I keep ſome of thoſe birds in cages; they are in good health, and feel no inconvenience from the treatment they have met with.

(i) M. de Meſte has told me, that having killed ſome pullets in the vapour or Mephites ſo well known by the name of the *Grotto del Cane,* near Naples, he remarked a ſavour manifeſtly acid in the lungs of thoſe which he opened after ſuffocation. This appeared more remarkable to him, as he was then of opinion, with many others, that the vapour was only fixed air.

acid vapour, if he had not immediately had recourſe to an Alkaline Spirit which was luckily at hand.

Experiments proper to ſhew that the Death conſequent upon an Aſphyxy, produced by the Acid Vapours called Fixed Air, *is occaſioned by the Effect of that Acid upon the Lungs.*

MY deſign in theſe new Experiments was, poſitively to determine the effects of the Acid Vapour of vinous fermentation on different ſpecies of animals; accordingly I took quadrupedes, birds, inſects and amphibious animals, and having ſubjected them to the influence of this vapour, the reſult more and more confirmed my former experiments.

I entreated Mr. *de Meſte*, a phyſician and able anatomiſt, to aſſiſt me in theſe experiments, which were performed jointly with the *Marquis d'Aouſt*, and M. *de Romé de l'Iſle.*

It is proper to acquaint thoſe who deſire to repeat them, that in order to perform them a-right, they muſt be in the *back (k)*, by the ſide of a vat in fermentation, becauſe of the great quantity of the Volatile Acid called *Fixed Air* neceſſary to be uſed: I ſhall alſo remark, that after ſtaying more than

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(*k*) The back is a large ſhallow veſſel in which the wort is cooled, before it is put into the vat to ferment.

than three hours in the acidulated atmoſphere of the brewery, ſome of the company found themſelves in a kind of intoxication, which was immediately diſſipated on their reſpiring ſome Volatile Alkali.

The Volatile Acid, or *Fixed Air*, we made uſe of in the greateſt part of theſe experiments, was active enough to kill a ſparrow in fifteen ſeconds.

Effects of the Acid of Vinous Fermentation upon Amphibious Animals.

THE frog, perhaps, reſiſts the deleterious action of the effluvia of vinous fermentation longer than any other animal; the reaſon apparently is, that being amphibious, a leſs quantity of air is ſufficient to keep it alive.

We obſerved, that the frogs which kept their mouths ſhut in the acid atmoſphere of the vat, remained alive a conſiderable time longer than thoſe which I had forced to keep their mouths open, and receive that acid vapour into their lungs, by the inſertion of a ſmall roll of paper.

Three frogs being put into a large glaſs veſſel, into which was poured the Volatile Acid of vinous fermentation, one of them kept its mouth open, ſwallowed rapidly of the acid, ſwelled a little, was then thrown into convulſions, which made it extend its paws as if it wanted to ſwim: it expired at the end of ſixteen minutes.

Another, that had kept its mouth conſtantly ſhut, ſhewed no ſigns of convulſions, and did not expire till after twenty minutes.

The frog into whoſe mouth I had inſerted a ſmall roll of paper, was violently agitated for the ſpace of five minutes, and died in ten.

Volatile Acid was introduced into the veſſel every four minutes, and we knew when it was full by the overflowing acid extinguiſhing a light placed at its orifice or edge.

Having opened the frogs, we taſted their lungs, and found them of a much more pungent ſavour than theirs which we had opened alive for the purpoſe of comparing them with the former; after chewing ſome of the laſt, a ſlightly-ſalt taſte only was produced, and that was the only method we uſed to verify the preſence of the Volatile Acid in that viſcus.

In four or five frogs which we deſtroyed in this acid vapour, we found the lungs diſtended and extremely dilated.

I ought likewiſe to remark, that I recalled to life ſome of thoſe frogs that had fallen into an aſphyxy, by putting their mouths upon a few drops of Volatile Alkali Fluor ſhed on the table.

Effect of the Acid of Vinous Fermentation on Inſects.

AFTER having put a Scarabæus Naſicornus with a Mole-Cricket into a glaſs veſſel, and poured a quantity of the Volatile Acid called *Fixed Air* upon thoſe inſects, the animals were violently agitated, and ſtruggled for ſome minutes, after which they remained almoſt motionleſs; the Mole-Cricket fell into an aſphyxy in half the time that the Scarabæus did, which lived in that atmoſphere eight minutes. In order to know if the Scarabæus, which was now motionleſs, might, by help of a ſtimulant, give ſtill ſome ſigns of life, we burnt its two hind-legs with a candle, but it did not move; I then put its head to ſome Volatile Alkali Fluor, and laid it on the table; a few minutes after it began to ſtretch out its paws: I put it again to the Alkali, which ſeemed to revive it more and more: at laſt, the inſect crawled, and in a little time entirely recovered its ſtrength; while another Scarabæus, which I had not preſented to the Volatile Alkali, periſhed entirely.

The Mole-Cricket which I had taken out of the veſſel, remained motionleſs on the table for a quarter of an hour. In this ſtate of aſphyxy, I preſented it to the Volatile Alkali, and put the animal's head to it; a moment after the inſect

ſect was agitated, it moved and crawled; at laſt, it recovered its full vigour; but another Mole-Cricket which I had not expoſed to the Volatile Alkali, paſſed from the ſtate of aſphyxy to death.

Effects of the Acid of Vinous Fermentation on Quadrupedes.

A female guinea-pig having been put into a glaſs veſſel, I had no ſooner introduced ſome Volatile Acid, than the animal ſtruggled and fell upon its ſide; three minutes after, its reſpiration became difficult and very ſlow; the inſpirations ſucceeded each other every five ſeconds: this critical ſtate continued a minute longer, and the animal expired. It was left three minutes expoſed on the table; then ſome motions we perceived in its belly, made us apprehend that it was not yet dead; but after opening it, we could eaſily perceive that the motions we had remarked in the animal's belly were produced only by a fœtus we found in it, which had ſtruggled in the entrails of the dam the inſtant of her death.

Another female of the ſame ſpecies, but not pregnant, loſt her life in three minutes; her lungs, as well as thoſe of the former, appeared to us ſub-acid.

Effects of the Acid of Vinous Fermentation on Birds.

HAVING put a pullet into a glaſs veſſel which was immediately filled with Volatile Acid, at the end of twenty-five ſeconds the animal drooped its head; twenty ſeconds after it foamed at the bill, and died in two minutes.

We immediately opened it, and found the heart ſtill palpitating: having taſted its lungs, we found their ſavour much more acid than that of the lungs of another pullet, which we opened when entirely alive.

The lungs of a third pullet, which we had put to a very lingering death in the acid atmoſphere of vinous fermentation, appeared to us to have a ſavour ſtill more ſharp.

Experiment which proves that Radical Vinegar, *far from being proper to revive Animals in an Aſphyxy, kills thoſe, which, after being expoſed to the Volatile Acid of Vinous Fermentation, ſtill retain the Faculty of Reſpiration, and ſome Uſe of their Limbs.* (*l*)

THREE birds were put into a veſſel where there was Volatile Acid or *Fixed Air* taken from a vat out of which the beer had been drawn at the bottom; they remained in it about ten minutes without dying; they were agitated, fell on their

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(*l*) This experiment was made in preſence of Marqueſſes *d' Aouſt* and *de la Billarderie,* the Count *de Cuitri,* and Meſſ. *de Meſte, de Romé de l' Iſle,* and *Faujas de Saint-Fond.*

ſides, and breathed with great difficulty, tho' they opened their bills wide. In this critical ſtate I took them out in order to expoſe them to the free air; having put ſome radical vinegar into my hand, I preſented it to the bill of one of the birds, which immediately fell into convulſions, breathed with more difficulty, and remained on its ſide without being able to riſe; a few minutes after repeating the adminiſtration of the radical vinegar it expired. Yet the ſecond bird, to which I had given nothing after its being taken out of the veſſel, dragged itſelf ſlowly along upon its feet: ſeeing that at the end of twenty minutes it had gained no more ſtrength, and was become in a manner paralytic, I gave it ſome Volatile Alkali; it ſhook its head, clapp'd its wings, and ſtood up: I made it ſmell to the Volatile Alkali a ſecond and a third time; it then recovered its full ſtrength; I put it again into its cage, and it is now in good health..

Having left the third bird expoſed to the open air, it lived there twelve hours in a kind of palſy, which did not permit it to move but on its ſide.---This ſtate of languor was followed by death.

The reſult of theſe experiments is, 1ſt. That amphibious animals live longeſt in the acid atmoſphere of vinous fermentation; next to them, inſects, quadrupedes and birds. 2d. That the ſmaller theſe laſt are, the ſooner they die. 3d. That the acid of Vinegar cannot be uſed as an antidote againſt the Acid Vapour deſignated under the name of *Gas* and *Fixed Air*.

II.

EFFECTS OF MINERAL VOLATILE ACIDS ON THE HUMAN BODY.

VOLATILE Acids affect the lungs in different ways; and it appears, that generally the lighter they are, the more rapid and dangerous is their action. After the Mephitic, the Marine Acid is one of the lighteſt; accordingly it more quickly affects the organs than the others.

If the vapour of Marine Acid be diffuſed in the atmoſphere, it occaſions a ſlight irritation, followed by a hoarſeneſs and extinction of the voice; but when that acid penetrates into the lungs in greater quantity, there comes on a ſpitting of blood which may be mortal.

The only thing neceſſary to prevent the danger of thoſe vapours is, to reſpire ſome Volatile Alkali the moment they are perceived; for, from the union of the Acid with the Alkali, is formed a mixture which has nothing in it corroſive.

Neither can people be too careful to guard againſt the vapours of the ſmoaking Nitrous Acid, as is proved by the following fact.

Two Philoſophers repeating an experiment where this Acid entered in conſiderable quantity, the moment that one of them thought it proper to unſtop one of the receivers, there iſſued from it a vapour of Nitrous Acid, in ſuch abundance, and ſo active, that they felt a ſhock ſimilar to the electrical. This vapour having in a moment filled the Laboratory, they were obliged to quit it, each of them ſeized with ſome degree of fever. This irritation, which would have been almoſt inſtantaneouſly prevented by the uſe of Volatile Alkali, was only increaſed by the adminiſtration of vinegar, which was then given them; and had ſuch an effect, that one of them was ſeveral days confined to his bed with a fever and delirium.

Obſervations on Mephitic Acids.

UNINFLAMMABLE *(m)* Mephitics *(n)* are only a Volatile Acid, ſimilar to that which is exhaled during

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(*m*) Inflammable Mephitics catch fire, only when brought in contact with a flaming body; the report with which they go off has various degrees of loudneſs. Theſe Mephitics appear to me to conſiſt of a Volatile Phoſphorus ſeparated from iron or zink by the Vitriolic Acid.

(*n*) By the name Mephitics, are deſigned inviſible and ſuffocating during vinous fermentation; ſuch is that of the *Grotto Del Cane* near Naples. If a veſſel with the tincture of Tourneſol be placed on the floor of the Grotto, it grows red almoſt inſtantaneouſly; if another be ſet with oil of tartar per deliquium, in a ſhort time there are formed cryſtals ſimilar to thoſe produced by the Acid of vinous fermentation combined with the ſame Alkali.

The demonſtrated identity of thoſe Volatile Acids, made me give them the name of *Mephitic Acid*, which may be ſubſtituted inſtead of *Fixed Air*.

When there is not a current of air in a ſubterraneous abode, the air found in it ſoon grows foul, both from the flame of the lamps, or other lights burnt in it, and by the reſpiration of the men aſſembled in it: The lights then grow dim; and in this caſe, no better method has been found, than to quit the place, though it is only neceſſary to introduce new air, or ſprinkle in it a quantity of Volatile Alkali, in order to neutralize the vapour. It would be an act of humanity, to give every Miner a bottle of this Alkali.

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focating vapours, found in ſome caverns; they are either acid or inflammable.

When

When many lights are kept in a place where a great number of people is aſſembled *(o)*, as in our theatres, *&c.* the place ſoon becomes unhealthy, unleſs care be taken to introduce ſeveral currents of air. Two cauſes here concur to vitiate the air: 1ſt, The Volatile or Mephitic Acid ſeparated from the inflamed bodies, which is no other than the Acid of the air, modified by an union with the *Phlogiſton* of the burning ſubſtances. 2d, The Acid iſſuing from the lungs in expiration, which, like the former, is only the Acid of the air modified, and become Mephitic ſimilar to the effluvia of vinous fermentation. If then any perſons fall into a ſyncope in ſuch places, the action of the Mephitic Acid muſt be oppoſed by the Volatile Alkali; and they will be much more eaſily recalled to life by the reſpiration of this Alkali, than by giving them vinegar; for the ſyncope is only the beginning of the aſphyxy, in which ſtate all Acids do more hurt than good.

When neceſſaries are opened, there often iſſues from them a Mephitic *(p)* vapour, ſometimes inflammable,

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(*o*) Burning oil, wax and tallow candles, and all kinds of greaſe produce the ſame effect of decompounding the air, which feeds the flame of thoſe ſubſtances.

(*p*) The human ſtercus contains a *hepar* of phoſphoric ſulphur, to which it owes its fœtid ſmell. *Hepar* of phoſphoric ſulphur, flammable (*q*), which ſuffocates the work-men: They fall into the Aſphyxy, and do not recover, till after having been expoſed to the free air, and brandy given to them; but I think that, in ſuch caſes, the Volatile Alkali would be more efficacious.

III.

Experiments, *ſhewing that the Effluvia of burning Charcoal is a Mephitic Acid, ſimilar to that of Vinous Fermentation, and which has been called Fixed Air.*

MEN and animals breathing an atmoſphere where there are burning-coals without a current of air, ſoon fall into an Aſphyxy. I was once of opinion, that the Acid of Vinegar might be a remedy in this caſe; but from my diſcovery, in the year 1772, that what is called Fixed or Mephitic Air was only a Volatile Acid, I ſaw clearly, that Volatile Alkali, not the Acid of Vinegar, was to be employed in this caſe, and the experiments I have ſince made have uniformly confirmed me more and more in the truth of this opinion.

ſulphur, when decompounded by an Acid, produces inflammable vapours. Vid. *El. of Mineral.* Vol. I. p. 48.

(*q*) The ventoſities formed in the bowels, and which iſſue with a *crepitus* are inflammable.

One of the reaſons by which I was determined to publiſh theſe obſervations on the pernicious effects of the effluvia of charcoal is, that the ableſt Phyſicians who have written upon this ſubject, ſeem unacquainted with the nature of that vapour. Some of them (as may be ſeen *pag.* 198. *Part IV.* of Mr. Pia's *Details ſur les Noyes* for 1775) have not even heſitated to aſcribe its effects to an *infernal power.* In *pag.* 263 of the ſame Work, we likewiſe find the following obſervation of Dr. Banau : " If Fixed Air be only an Acid, it " ſeems natural to believe, that an Aſphyxy " might be cured by making the patient ſwallow " a liquor ſlightly alkaline." But it is reaſonable to preſume, that Mr. Banau had no ſtrong confidence in the truth of what he wrote, as in the aſſiſtance he gave about the ſame time to perſons ſuffocated by the vapour of charcoal, he did not uſe Alkali, but Vinegar.

From the analyſis of charcoal, the reſult of which I gave in my *Elements of Mineralogy*, it appears, that this produce of vegetable ſubſtances modified by fire, is a ſpecies of ſulphur compoſed of phoſphoric acid, abſorbent earth, a ſmall quantity of iron, and a ſubſtance produced by burnt oil, which gives it a black colour. When brought into contact with an inflamed body in the open air, it immediately catches fire, and is decompounded, diffuſing in the atmoſphere an Acid *(r)* ſurcharged with inflammable matter. If a current of air be not introduced into the place where *braiſe* (*ſ*) or charcoal has been kindled, the air is decompounded; apparently the effect of the great quantity of Volatile Acid, or from its being ſurcharged by the phlogiſton ſeparated from the charcoal, and from the combination of the inflammable principle of the charcoal with the Acid of the air: but this union cannot be formed without overturning the equilibrium of the conſtituent parts of the air, from which the water ſeparates at the ſame time.

In my *Elements of Mineralogy*, *(tit. II. p.* 379 *and* 380*)*, I have given an account of ſome experiments, which prove the air to be a compound of water, phoſphoric acid, and an inflammable principle. There too may be ſeen one method of preventing the Acid vapours of charcoal from becoming mortal, *viz.* by boiling water on it. The

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(*r*) One hundred pounds weight of charcoal contain about ninety-eight pounds of phoſphoric Acid, for they do not yield above 2lb. of aſhes. Mineral and animal coals, when burnt in like manner, diffuſe a Volatile Acid in the atmoſphere; they differ from vegetable coal only, by containing a greater quantity of earth.

(*ſ*) *Braiſe* is charcoal, partially decompounded; it is light and very brittle.

reaſon is, That by the union of the Acid, ſeparated from the coal, with the water evaporated by ebullition, there is a continual production of new air, which replaces that conſumed in feeding the fire: unleſs this precaution be taken, the cloſe place where the coals are burnt, inſtead of containing reſpirable air, is filled with a Volatile Acid of greater ſpecific gravity. Of this truth any one may be convinced, by ſetting in the place a few veſſels with tincture of Tourneſol; for the red colour aſſumed by the tincture, indicates the preſence of an Acid. If Fixed or Volatile Alkali be expoſed to this Acid, they are criſtallized by it; and by its union with them are formed ſome neutral ſalts, of which I have given an account in my *Analyſis of Corn.*

I am inclined to believe, that in the circumſtances juſt mentioned, the Aſphyxy is produced by the penetration of the Volatile Acid into the lungs: In fact, I have obſerved, that by introducing Volatile Alkali into the noſtrils and down the throats of dogs that I had ſuffocated by the vapour of charcoal, they recovered almoſt as ſpeedily as the animals I had ſuffocated by the Acid vapour of vinous fermentation.

Upon a very attentive peruſal of Mr. Harmant's paper, on the means of recovering perſons ſuffocated by the Vapour of Charcoal, I obſerved, with ſurpriſe, that that celebrated phyſician had made no uſe of Volatile Alkali.

Mr. Portal, in his Diſſertation on the Effects of Mephitic Vapours, has obſerved very juſtly, that "when they penetrate the lungs, the blood ſtops "in the veſſels of that viſcus, and accumulates in "thoſe of the head, which produces a mortal Apo"plexy in perſons expoſed to thoſe vapours. It "is the buſineſs of the natural philoſopher," continues he, "to determine the qualities of the dif"ferent kinds of foulneſs, by which the air is "corrupted." If, in our treatment of perſons labouring under an aſphyxy, and in the choice of proper remedies, we ought to uſe this knowledge as our guide; and it is a certain truth, that we ought; there is reaſon to hope, that we ſhall no longer be the ſlaves of cuſtom; and that when the acidity of the mephitic vapour of charcoal is once acknowledged, Volatile Alkali will be ſubſtituted for vinegar, which, in ſuch circumſtances, is rather pernicious than ſalutary.

I know it has been aſſerted by many, that Volatile Alkali acts only as a ſtimulant, and therefore vinegar might produce the ſame effect: But I think I have inconteſtably demonſtrated, that in the Aſphyxy, which is almoſt conſtantly produced by an Acid taint, the Volatile Alkali did not act merely as a ſtimulant, but combined with the

Acid, which penetrated into the lungs. On the contrary, I have remarked, that the Acid remedies, uſed in Aſphyxies, had almoſt conſtantly haſtened the death of the animals on which they were tried.

I have been lucky enough to recover a man who was ſuffocated by the vapour of charcoal, by inſerting into his noſtrils a paper-match, thoroughly ſoaked in Volatile Alkali, and pouring into his mouth a few drops of it. Tho' I did not uſe aſperſion, I think that ought not to be neglected, if the Volatile Alkali does not immediately reſtore to the patient a power of motion.

The method I make uſe of to deſtroy the dangerous effects of the vapour of charcoal, and reſtore the air to its purity, is as follows: Care is firſt taken to be well aſſured of the ſtate of the atmoſphere of a ſuſpected place, by plunging into it a lighted wax taper, fixed to the end of a pole: If the light be extinguiſhed, 'tis an evidence, that the atmoſphere is mephitic, or ſurcharged with acid; if that Acid be in leſs quantity, the light grows languid, and diffuſes only a pale, unſteady glimmering: but we muſt be attentive to preſent the light at different heights; for I have had occaſion to remark, that a taper which burnt very well, at the height of one foot from the floor of a chamber, (*t*) where there had been burning charcoal, languiſhed in the middle, and went out a foot from the cieling. In a ſimilar caſe, I threw into the chamber a bottle, containing an ounce of Volatile Alkali Fluor, taking care immediately to ſhut the trap I had made in the glaſs door; half a quarter of an hour after, I again introduced the candle, which burned very well wherever it was moved; after which I entered without meeting the leaſt accident.

IV.

OF DROWNED PERSONS.

BY the experiments performed upon drowned perſons, it ſeems to be demonſtrated, that the cauſe of the ſuffocation is not the water ſwallowed, nor that introduced into the lungs, (*u*) but merely the ſtoppage of reſpiration.

It is now no longer a doubt, that the air expired from the lungs is mephitic, *i. e.* a deleterious

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(*t*) This chamber was a ſquare of eight feet by ſix in height.

(*u*) From the experiments of Meſſ. Daubenton, and Vicq. d' Azyr, it appears, that a little water penetrates into the breaſt of drowned perſons; in order to prove it, they ſunk ſome dogs and rabbits in water in which yellow ocre was ſuſpended, and ſome marks of it were found in their lungs.

Acid, which is improperly called air, becauſe it is no longer fit for reſpiration. If, by the help of a tube, this pretended air be introduced into the tincture of turneſol, it very ſoon turns it red, which indicates the acidity of this mephitic vapour. From this experiment it ſeems to me, that the aſphyxy of drowned perſons may be thus accounted for: The portion of air remaining in the lungs being there decompounded, the reſulting mephitic acid puts a ſtop to the functions of that viſcus; hence the Aſphyxy, which, as I have demonſtrated in the former obſervations, is equally produced by the mephitic acid of vinous fermentation, and the effluvia of burning charcoal: in theſe different caſes it is always an Acid, which penetrating the lungs, ſtops the functions of that viſcus. It is therefore evident, that Volatile Alkali, by combining with this acid, muſt neutralize it, and form a mixture containing nothing injurious; the external air now finding no obſtacle to its entrance, the ſpaſm, cauſed by the acid having penetrated into the lungs muſt inſtantly ceaſe: for that reaſon I dare aſſert, that far from looking upon Volatile Alkali only as an acceſſary in the treatment of drowned perſons, it ought to be employed as the firſt and principal remedy, which appears to have been the opinion of that reſpectable Citizen (Mr. Pia) the firſt in this country who publiſhed the methods of recovering drowned perſons *(x)*. I ſhall here mention a late inſtance of the efficacy of Volatile Alkali in the caſe before us. July 20th of this year (1777), a man intoxicated with liquor having perceived ſome people dreſſed *en Scaphandre (y)*, in the river Seine, beyond the Hoſpital, thought he might, like them, walk in the water: whether he ſuppoſed it to be ſhallow there, or thought he could ſwim well enough to ſecure himſelf from danger; whatever was the caſe, he pulled off his cloaths, and plunged into the river in a moment: in vain did the people call out to him to take care, he did not regard them, but applauded himſelf ſo long as he kept his feet; however, the current ſoon hurried him away, and he diſappeared. For ſome minutes he was not to be ſeen, at laſt his feet appeared above water; and again he diſappeared. He had been below water above twenty minutes, when a waterman drew him out motionleſs, his pulſe gone, his eyes open,

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(*x*) *The animated camphorated brandy*, which is found in Mr. Pias' box for drowned perſons, is made with a French pint of good brandy, half an ounce of camphire, and an ounce of volatile ſpirit of ſal-ammoniac, prepared from ſlaked lime.

(y) The *Scaphandre* is a dreſs, by the help of which people walk and move up and down in the water without fear of drowning. It is a jacket made of cork, ſewed and covered in cloth.

and fixed. One of the people who were ſwimming by help of the *Scaphandre (z)*, came into the boat, introduced ſome Volatile Alkali into his noſtrils, and poured four or five drops of it into his mouth; the man then uttered a vehement ſigh, threw up a foamy water, and riſing up, cried, *I am very well.* He was a mechanic: the waterman ſeeing him on his legs, ſaid, *I wiſh I had taken him to the guard-room while he was drowned, I ſhould have got a Louis*; the other, who by this time had put on his cloaths, thinking by theſe words they intended to put him into priſon, jumped aſhore, and ran off with full ſpeed.

In the fouth part of the Details of Drowned perſons publiſhed by Mr. Pia for the year 1775, pag. 152, it is ſaid, that Mr. Midfort, an Engliſh Surgeon, recovered a young woman that had drowned herſelf in the Thames, by making her ſmell to Volatile Alkali, and by pouring into her mouth a mixture of the ſame volatile ſpirit and water, which ſoon reſtored her to her ſpeech, and a little after ſhe went home in a coach.

Wiſhing to determine if it was poſſible to bring to life perſons apparently drowned, by the

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(z) Monſ. Gautherot, Muſic Maſter to the Dutcheſs of Chartres.

uſe of Volatile Alkali alone; I drowned ſome quadrupedes, and I have perceived that by the means of this Alkali alone life was ſoon reſtored.

Theſe experiments were made on rabbits *(a)* that I drowned, holding them by the paws *(b)*: at firſt they ſtruggled very hard, but ſome minutes after they ceaſed to give the leaſt ſigns of life.

Having thus drowned two of theſe animals, there iſſued from their mouths a whitiſh frothy liquor, that ſwam on the water. Having taken them out, I put them in a napkin, where they did not give any ſigns of life; but ſcarcely had I poured ſome drops of the Volatile Alkali into their mouths, and rubbed their noſtrils with it, when they gave ſome ſigns of motion: I then put ſome Volatile Alkali under their noſtrils; they immediately moved their paws, ſtretched them out, opened their eyes, ſhook their heads, and got up. I again put into their mouths a little

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(a) My Lord Biſhop of Agde, M. Courin, of the Academy of Sciences, and many other Perſons, were in my Laboratory when I made one of theſe experiments.

(b) They muſt not be held by the ears, for by that method, it may happen that theſe animals may periſh from their ſtruggling in the water.

Volatile Alkali and water; but as they ſhivered, I put them into the napkins, where they did not continue long before they recovered, and preſently ran about.

I have repeated this experiment upon other rabbits, and was equally ſucceſsful: but it is neceſſary to obſerve here, that putting too great a quantity of the Volatile Alkali in the mouth, muſt be carefully avoided; for then it cauterizes it ſo much, that I once deſtroyed one of theſe animals which I had brought to life, by making it take too ſtrong a doſe.

From theſe experiments, I think we ought to begin our treatment of drowned perſons, by putting ſome Volatile Alkali into the noſtrils by means of two paper matches, and making them ſwallow twelve or fifteen drops of the Volatile Alkali mixed with water; if the ſenſes and the pulſe do not return at the firſt attempt, it muſt be repeated, and then proceed to the methods directed in thoſe caſes by M. Pia, and the other friends of humanity who have written on this ſubject. Motion, friction, with hot flannels, drinking ſome *l' Eau-de-vie, camphrée animée*, bleeding, &c. ought to be employed; but above all patience is moſt neceſſary; for there are inſtances of drowned people, who have not given ſigns of life till the end of many hours, during which the rubbing had never been diſcontinued; and endeavours had been inceſſantly uſed to revive them by the ſtimulants which I have juſt mentioned.

Of the Poiſon of the Viper.

THE venom of the viper reſembles in colour and taſte the oil of ſweet almonds; it is contained in veſicles which are found under the reptile's teeth, when it raiſes them to bite; the veſicle being then compreſſed, the poiſon inſinuates itſelf by the longitudinal groove, ſituated on the concave and internal part of the tooth.

From the experiments in the *Experimenta circa varias res naturales*, by Francis Redi, we learn, that the poiſon of the viper produces no miſchief when ſwallowed even in a large quantity. This author reports, that one of thoſe men whoſe buſineſs it was to collect vipers, named Jacob Sozzi, took before an aſſembly of learned men one ſpoonful of the venom of vipers without receiving any injury; he alſo drank wine in which he had received the poiſon of many irritated vipers, without being ſenſible of the leaſt bad effect.

Francis Redi ſoon after repeated nearly the ſame experiments: he put into a glaſs of water the heads of four vipers, ſtill half alive, whoſe lips and palate he had ſcratched with a lancet; he divided into two parts this unpleaſant beverage, and gave one part to a goat, and the other to a duck; but the poiſon did not ſeem to produce any ſenſible effect.

We know from experience, that many things perfectly harmleſs when taken into the ſtomach, become violent poiſons when receiv'd either at an inciſion or where the veſſels of the ſkin are torn or wounded, and they immediately paſs into the blood.

Cartheuſer relates in his *Materia Medica*, that the wounds of arrows dipped in the juice of black Hellebore are mortal, altho' a decoction of the ſame plant taken by the ſtomach only produces a gentle purging, and when continued occaſions no bad effect.

M. de Paw, when treating of the poiſoned arrows of the Oroonoko Indians, ſays, "When a ſavage is about to make uſe of his poiſoned arrows, he takes care to moiſten them with his ſaliva, and puts them into his mouth without fear; for the poiſon with which they are armed acts only when it is mixed with the blood, which it ſuddenly coagulates; the wounded animal drops down dead with more precipitation than if a ſtream of *Aqua Fortis* had been injected into the veins, which poiſon has likewiſe the property of fermenting the blood, and rendering it grumous even in the Auricles of the heart in leſs than two minutes." After this it is eaſily perceivable, that there is no danger in eating the game killed with thoſe envenomed arrows. *Recherch. Philoſoph. ſur les Americains*, *Tom. II. p.* 244. *et ſeq.*

Thoſe acids which, when taken internally in ſmall quantities, are often ſalutary, produce the moſt violent diſorders in the animal œconomy, and even death itſelf, when they paſs immediately into the blood: if a few drops of them be injected into the veins of an animal, it falls into convulſions almoſt immediately, and its death follows in a very ſhort time.

We are indebted to Dr. Mead for the diſcovery of the nature of the viper's poiſon. Tho' this poiſon be not ſenſibly acid to the taſte, the experiments of that able phyſician ſhew, that an acid is contained in it, which ſeparates ſpontaneouſly when the poiſon is expoſed to the air.

Dr. Mead relates, that after having put on a plate of glaſs ſome poiſon of vipers which he had provoked, and cauſed to bite a hard body, he examined it by help of a microſcope, and immediately perceived ſome ſaline particles rapidly floating in the liquor; after ſome time theſe were formed into very ſlender, and extremely ſharppointed cryſtals, on which were obſerved a kind of knots; theſe cryſtals were tranſparent, and gave a red colour to the tincture of Tourneſol, but made no alteration in that of blue violets. This laſt property is found in the marine volatile or mephitic acid, which is known to change the colour of the firſt of thoſe tinctures into red, while it produces no alteration in the other.

When the viper bites, it introduces its poiſon into the wound; which inſinuating itſelf into the veſſels, by degrees coagulates the blood, interrupts the circulation, and brings on death, unleſs a remedy be applied.

It has been remarked, that ſmall animals die ſooner than large ones, when bitten by the viper; and thoſe which received the poiſon from the viper itſelf, than thoſe into whom it had been introduced by means of an inciſion. Some pullets which died of a bite, have been eaten by men without inconvenience; which is conformable to the account I have given above from Mr. Paw, of the game killed by the poiſoned arrows of the Americans.

Dr. Mead had demonſtrated that the venom of the viper was acid: tho' the application of the remedy ſeemed naturally to flow from the knowledge of this, it was reſerved to Bernard de Juſſieu to make the firſt experiment of it.——We find in the Memoirs of the Academy of Sciences for the year 1747, the uſe made of Volatile Alkali by that celebrated botaniſt, on a perſon that had been bit by a viper in three places, viz. the thumb and fore-finger of the right hand, and thumb of the left. He felt almoſt immediately an umbneſs in his fingers, which ſwelled; the ſwelling ſpread to his hands, and became ſo conſiderable, that he could not bend his fingers. Mr. de Juſſieu made the patient take ſix drops of Volatile Alkali in a glaſs of water; and a quantity of it was poured upon each wound, ſufficient to bathe and rub into it: it was then one o'clock afternoon, and extremely hot weather; at two the patient complained of a ſickneſs at his heart, and fainted away; but it ceaſed on his taking a ſecond doſe of the Volatile Alkali *(c)*.

The ſame remedy was again adminiſtered to the patient at different intervals, both externally and internally. Next day the ſwelling of his hands ſtill continuing, an embrocation was applied of olive-oil, in which was mixed a ſmall quantity of

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(c) This ſecond doſe was given in wine; but the Volatile Alkali combining with the Acid in that fermented Liquor, the wine grows black, and keeps the Sal Ammoniac in a ſtate of diſſolution; the Alkali therefore ought to be taken only in water.

Volatile Alkali. The effect of this remedy was ſo ſpeedy; that half an hour after the patient could freely move his fingers. At the end of eight days he was entirely cured; the ſwelling and numbneſs of his hands, and a yellow tinge which on the third day appeared on the fore arms, were diſperſed by the uſe of the Volatile Alkali, of which he took two drops in a glaſs of water three times a-day.

That the application of Volatile Alkali may be ſucceſsful in the bite of a viper, it muſt be made almoſt immediately, which I have verified by expoſing pullets to be bitten by vipers. Thoſe to whoſe wounds I did not apply the Volatile Alkali till half an hour after the bite was given, died in ſome hours; but thoſe to which I immediately applied a compreſs of the Alkali, recovered. It is proper to obſerve, that I did not adminiſter Volatile Alkali internally to thoſe pullets.

The doſe ought to be proportioned to the ſtrength and ſize of the animal: perhaps, then, ſo large a quantity as a drachm might be adminiſtered to oxen: but the moſt eſſential part is the application of compreſſes to the bites, and, if the ſwelling be conſiderable, embrocations.

VI. OF

VI.

Of the Puncture of Insects.

ALL animals contain a portion of phoſphoric acid; but it is commonly combined with Volatile Alkali, and under the form of Sal Ammoniac, or it is found in the ſtate of a phoſphorus, by uniting with a ſufficient quantity of inflammable principle to conſtitute the oil and fat of thoſe ſame animals. The phoſphoric acid is found by itſelf in inſects more frequently than in any other members of the animal kingdom; of which ants and ſeveral of the winged tribe are a proof: in fact, 'tis to this acid concentrated that we muſt attribute the kind of burning heat we feel when we handle ants. The ſwelling produced by the ſtinging of bees, of waſps and gnats, is likewiſe cauſed by the introduction of a ſimilar acid into the ſubſtance of the ſkin.

In thoſe inſects which ſhine in the dark, and are called *phoſphoric*, ſuch as glow-worms, &c. the animal acid is found combined with a ſufficient quantity of inflammable principle to produce a ſubtile phoſphorus, often very ſhining.

The punctures made by inſects are commonly accompanied with redneſs, heat, burning and ſmarting,

ſmarting ſo conſiderable as to oblige the perſon to ſcratch himſelf, which produces a ſwelling; tho' this is often the immediate conſequence of the puncture: but neither the ſmart, inflammation, nor ſwelling will take place, provided a little Volatile Alkali be immediately applied to the part: the Alkali uniting with the acid introduced into the ſkin by the inſect, immediately ſtops its effects.

In ants, the acid is ſufficiently concentrated to penetrate the texture of the ſkin, and make it thick, tranſparent and horny, as I have found by picking them up for the experiment's ſake. The two fingers between which I took them became almoſt inſenſible at their extremities, which grew whitiſh and half tranſparent: having ſoaked them in Volatile Alkali, the ſwelling ceaſed, and the ſkin returned to its ordinary ſtate.

Since the curious experiments made by Mr. Margraaf on this inſect, there no longer remains any doubt with regard to the acid of ants: but being deſirous of knowing whether the mephitic emanation from thoſe inſects was likewiſe acid, I overturned an ant-hill, and then ſet upon it a bell-glaſs, in which was a ſmall Phial with tincture of Tourneſol. Having taken it out again with precaution, I found the tincture turned red.

In the *Journal de Médicine*, for Sept. 1762, Mr. Roux relates, that a living frog being expoſed upon an ant-hill, died there in leſs than four or five minutes, tho' it is not neceſſary to ſuppoſe it to have been bit by thoſe inſects. That phyſician ſays, that on handling ants, he felt in the evening a ſlight heat in his fingers, which ſwelled and grew red; the next day the epidermis ſeparated from the cuticle, and his fingers peeled.

Mr. Roux likewiſe quotes the following fact, communicated to him by the Baron d' Holbac:

A man being deſirous of deſtroying an ant-hill, covered it with a bell-glaſs, imagining that the heat thus produced would be ſufficient to deſtroy the ants. The experiment had the deſired effect; but when he wanted to take off the glaſs, putting his face too near the orifice, he ſmelt a ſtrong vapour, which immediately gave him a violent head-ach. By degrees his body ſwelled; the patient felt ſuch agitations, mixed with anxieties, that his life was apprehended to be in danger. In this condition he continued all night: next day a violent eruption appeared on his ſkin, and he gradually became eaſy. This eruption, which was of an uncommon kind, laſted three days, and then his ſkin ſcaled off.

The fact now quoted ſeems to me a deciſive proof of the acid or mephitic quality of the emanation of ants. I ſaid before, that after having handled thoſe inſects, I diſſipated the ſwelling of my fingers by rubbing them with Volatile Alkali. I am likewiſe of opinion, that when a perſon is affected with the emanation of their Volatile Acid, the only method of curing him, is by having recourſe to the Volatile Alkali, to reſpire its vapour, and to pour ſome into the hollow of the hand, that its evaporation being aſſiſted by the heat, it may more readily unite with the acid which had penetrated into the pores of the ſkin, and ſtop its effects. I even think that, if a head-ach be felt immediately after being expoſed to the vapour of an ant-hill, ten or twelve drops of it may be taken in a glaſs of water without ſcruple.

VII. OF BURNS.

I Have elſewhere given an account of the method in which I have been led to uſe Volatile Alkali for burns *(d)*. I have ſhewn that the phoſphoric acid, highly concentrated and heated *(e)*,

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(d) See my *Analyſis of Corn*, page 99.

(e) Only thoſe Bodies in which Phoſphoric Acid reſides in the ſtate of Phoſphorus, are capable of producing Light or Heat, but that Acid is diffuſed almoſt every where.

> Ignis ubique latet naturam amplectitur omnem,
> Cuncta parit, renovat, dividit, urit, alit.
>
> VOLTAIRE.

penetrating into animated bodies, deſtroyed or modified their texture in different manners, which produces a diſtinction of burns into three kinds.

In the firſt, puſtules and redneſſes are produced on the ſkin, and the epidermis and ſkin are frequently ſeparated.

In the ſecond are formed *Hydatides*, where water is found between the epidermis and ſkin, which cauſes veſicles of different ſizes.

The third, ſort where the ſkin is ſcorched, dried, and chopt.

The Volatile Alkali is to be uſed in three different ſtates, according to the ſpecies of burns. In the firſt and third ſpecies, it is ſufficient to apply to the burn a compreſs of the ſtrongeſt Volatile Alkali Fluor; the pain immediately ceaſes, and commonly in eight or ten minutes there does not remain the leaſt veſtige of them.

Some glaſs of Borax in fuſion having one day dropped upon my fingers, the ſkin was ſo much burned, that a riſing was formed like a wart. I immediately applied ſome Fluor Volatile Alkali, and in half an hour I was at eaſe: I remarked, that inſtead of the riſing there was a cavity in the muſcles of the fingers which had been burned.

The ſecond ſpecies, which I have ſaid is accompanied with *Hydatides*, is commonly cauſed by boiling water. Here it is proper to break the bladders, after which apply compreſſes with water mixed with Volatile Alkali Fluor: the proportion is about two drachms of Volatile Alkali to about an Engliſh quart of water. Theſe compreſſes are renewed thrice a day, and in a very little time the cure is compleated.

The burn cauſed by Kunckel's Phoſphorus is very painful; the edges of it become callous, from the phoſphoric acid being very much concentrated and intimately combined with the phlogiſton: this burn too is eaſed and cured by an immediate application of the Volatile Alkali.

The vitriolic acid being of all others the heavieſt next to the phoſphoric, its effects upon the animal or vegetable texture bear the greateſt analogy to a burn.

One day I was aukward enough to throw ſome oil of vitriol on my face; that inſtant it was covered with white puſtules, which gave me exceſſive pain. I waſhed my face in water, and the anguiſh abated; but next day it was covered with a yellowiſh ſcab, which would not have been the caſe had I uſed an Alkaline water, ſuch as I have mentioned above.

From this theory of burning I am induced to think, that Volatile Alkali might be employed with ſucceſs in the *Coups-de-Soleil*; but having never tried it, I muſt leave the proof of that conjecture to experience.

VIII.

VOLATILE ALKALI SUCCESSFULLY EMPLOYED IN CANINE MADNESS.

OF all the evils by which mankind is afflicted, perhaps the nature and character of Canine Madneſs are leaſt known *(f)*. It is believed that no human creature was ever ſeized with it, except from the bite of ſome mad animal. It has even been remarked, that the poiſon is communicated by the ſaliva, and that the wounds made thro' the cloaths are leſs dangerous than thoſe made in the bare ſkin: the reaſon is, that in the firſt caſe the ſtuff partly cleans the teeth of the animal. In general it is obſerved, that the greater progreſs the madneſs has made, the more difficult and obſtinate is its cure.

(f) We are indebted to Mr. Laſſone for an excellent method of treating canine madneſs. That learned phyſician ſays, that this dreadful diſtemper is one of thoſe with whoſe nature and character we are leaſt acquainted.

When a perſon is bit by a mad animal, the wound heals ſometimes as eaſily, as if it had not been envenomed; but ſome time after, and the time varies from three weeks to three months, a dead pain begins to be felt in the part that was wounded; the ſcar ſwells, grows red, opens again, and diſcharges a reddiſh, fœtid, acrid humour. The patient is then ſeized with melancholy, indolence, and a general torpor, accompanied with almoſt continual chillineſs, a difficulty of breathing, and unceaſing anguiſh; the pulſe is weak and irregular, the ſleep diſturbed, unquiet, broken with frightful dreams, ſtartings, terrors; ſometimes a pain is felt in the throat: this is the firſt ſtage of the diſtemper, or what is called by the French, *Rage mue.*

The ſecond ſtage, or confirmed madneſs, called by them *Rage blanche*, is accompanied with the following ſymptoms: The patient is preſſed with a burning thirſt, and drinking is painful to him; he ſoon contracts a hatred for all liquids, particularly water, and a few hours after abhors it: his urine grows thick and hot, and ſometimes is ſuppreſſed; his voice becomes hoarſe, and is often entirely loſt; the patient is ſeized with fits of delirium intermingled with furious madneſs, on which occaſions he attempts to bite. When the diſorder is come to this pitch, it is commonly regarded as incurable.

If we examine the different methods uſed in the treatment of canine madneſs, we ſhall find thoſe hitherto moſt ſucceſsful where Volatile Alkali has been applied. Mr. Tiſſot in his *Advice to the People*, page 219, ſays, That a boy in whom the ſymptoms of the madneſs began to ſhew themſelves, was entirely cured by giving him ſome doſes of *Eau de Luce*, and rubbing the parts adjacent to the wound with olive-oil in which camphire and opium had been diſſolved.

Mr. de Laſſone, an eminent phyſician, and member of the Royal Academy of Sciences, publiſhed in 1776, a method for curing canine madneſs, in which he recommends, as one of the moſt efficacious remedies, a doſe of twenty-four drops of Volatile Alkali Fluor, to be taken inwardly twice a-day. The reader will ſee with pleaſure the ſucceſs of this method in the work of Mr. de Laſſone, and the obſervations of Mr. *Blais (g)*.

(g) Mr. Blais, phyſician at Cluny, has ſhewn his philanthropy in the horrible ravages committed in ſeveral villages of the Maconnois by a mad wolf: the ſucceſs of his method does him the greateſt honour.

A young woman being bit in the hand by a little dog, the dog-doctor pronounced the animal to be mad, and imprudently killed it in her preſence; ſhe was ſeized with terror and deſpair. Mr. Belleteſte, a phyſician, being called in, approved of the application of Volatile Alkali in a compreſs on the wound, and a doſe of eight or ten drops of the ſame Alkali to be taken in a glaſs of water every three hours the firſt day; the compreſs was kept moiſt with water mixt with one-ſixth part of Volatile Alkali. During the three following days only one doſe of this Alkali was given in the morning, and another at night; after which the wound appearing to be cicatrized, the medicine was diſcontinued, and the young woman has never ſince felt any inconvenience from the bite.

Another woman advanced in years having been bit by a mad cat, the wound cloſed: this woman did not appear affected with it; but at the end of three weeks, the wound opened again, ſwelled and grew black; and a reddiſh fœtid humour iſſued from it. This woman had, beſides, all the ſymptoms of madneſs; ſuch as convulſive motions, accompanied with ſtartings in her ſleep, white foam on her lips, &c.

I adviſed the application of a compreſs of Volatile Alkali Flour on the wound, which was kept moiſt for twenty-four hours by other compreſſes ſoaked in water, mixed with a ſixth part of Volatile Alkali Fluor; twelve drops of the Alkali were alſo given her every two hours in half a glaſs of water.

Next day the blackneſs of the wound diſappeared, and the ſwelling was much diminiſhed; the uſe of the Volatile Alkali was continued twenty-four hours longer, both in compreſſes and inwardly; at the expiration of theſe two days the convulſions ceaſed, the patient's ſleep returned with its ordinary quiet; and the wound being almoſt cicatrized, it was thought ſufficient to put a piece of lint upon it; the woman returned to her ordinary regimen, and during the two years ſhe lived afterwards, felt nothing from that accident.

It is proper to obſerve, that the Alkali uſed by Meſſrs. Tiſſot, Laſſone, and Belletête, was the Volatile Fluor, as was likewiſe that adminiſtered to the old woman I have juſt mentioned. If then the application of Volatile Alkali in caſes of canine madneſs has ſometimes not been attended with the deſired effect, it is, doubtleſs, becauſe uſe has been made only of ſpirit of hartſhorn, where the Volatile Alkali, being in a ſoapy ſtate, has almoſt no effect.

IX.

OF THE EFFECTS OF VOLATILE ALKALI IN APOPLEXY.

ASphyxy (as was bfore obeſerved) is a ſudden privation of the pulſe, reſpiration, motion, and feeling; apoplexy is likewiſe a privation of motion and of all ſenſe; but it differs from Aſphyxy, in that the lungs continue to play, and the blood to circulate. It is accompanied with a difficulty of breathing, and a kind of ſnoring; in this ſtate the pulſe is more or leſs weak: in general, apoplexy is almoſt always ſucceeded by a palſy.

While I was forming a ſcale of the effects of the mephitic acid of vinous fermentation upon different ſpecies of animals, I remarked, that before they fell into aſphyxy, they loſt the faculty of motion, their reſpiration became ſlow and difficult, and their efforts to riſe were fruitleſs; this ſtate appears very ſimilar to an apoplexy; at laſt thoſe ſame animals ſometimes recovered ſtrength enough to move, roſe, and almoſt immediately fell down; in this paralytic ſtate they ordinarily continued ſome hours, and then died: but when I made ſuch of thoſe animals as were only in a ſtate of apoplexy reſpire the Volatile Alkali, they recovered their full vigour almoſt inſtantaneouſly.

I am not vain enough to pretend to aſſign the cauſes of the common apoplexy, but I am certain from experiments, that Volatile Alkali taken internally in the beginning of the fit ſtops its progreſs; that ſenſe, ſpeech and motion almoſt immediately return, and the patient recovers his former vigour.

I was witneſs of what I am going to relate: One *Jacques (b)*, foreman in the royal garden of plants, having fallen into an apoplexy, and being almoſt deprived of all feeling, he was firſt made to ſmell to ſome Volatile Alkali, then twenty-five drops of it were given him in half a glaſs of water; his pulſe quickened, and he opened his eyes: four minutes after a ſecond doſe of the Alkali was adminiſtered, his ſenſe and ſpeech returned, and the contraction of the muſcles of the mouth diſappeared.

During the night, five or ſix drops of Volatile Alkali were given him every two hours in half a glaſs of water, and he was up next day. Tho' at that time the man felt no more inconvenience from the accident, a doſe of four drops was adminiſtered every four hours in a glaſs of water during the whole day; and on the third, he was able to return to his work.

(*b*) Aged Sixty, of a groſs and ſanguine habit.

The following fact is equally important: A terrace-maker, a ſtout and vigorous man, about thirty-four years of age, working in the king's garden at one o'clock afternoon, in the month of July, fell into a kind of aſphyxy; his fellow-workmen thought him dead. Mr. Thoüin, the king's gardener, was ſent for, who, after viewing the unfortunate man, came and informed me that a labourer in the garden had juſt died ſuddenly. Having gone to the ſpot, I found him without motion, pulſe and feeling; he had been in this condition above a quarter of an hour, and I thought him dead; but being unwilling to have any cauſe to reproach myſelf with neglecting the means of recovering him, I put ſome Volatile Alkali into his noſtrils, and having cauſed his jaws to be forced open with a chiſſel, I poured into his mouth forty drops of it diluted with four parts water. Some ſeconds after he opened his eyes, and his pulſe began to play; but a minute after, his eyes cloſing again, and his pulſe ceaſing to beat, I again put Volatile Alkali into his noſtrils, and made him ſwallow a ſecond doſe of it; he then came entirely to himſelf, vomited a quantity of water, and a quarter of an hour after got up to return to his work.

FINIS.